

Combined Effects of Spaceflight and Age in Astronauts as Assessed by Areal Bone Mineral Density [BMD] and Trabecular Bone Score [TBS] **A14012372**

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Spaceflight is a potential risk factor for secondary osteoporosis in astronauts. Although lumbar spine (LS) BMD declines rapidly, more than expected for age, there have been no fragility fractures in astronauts that can clearly be attributed to spaceflight. Recently, astronauts have been returning from 6-month spaceflights with absolute BMD still above young adult mean BMD. In spite of these BMD measurements, we project that the rapid loss in bone mass over long-duration spaceflight affects the bone microarchitecture of the LS which might predispose astronauts to premature vertebral fractures. Thus, we evaluated TBS, a novel texture index correlated with vertebral bone microarchitecture, as a means of monitoring changes to bone microarchitecture in astronauts as they age. We previously reported that TBS detects an effect of spaceflight (~6-month duration), independent of BMD, in 51 astronauts (47+/-4 y) (Smith et al, J Clin Densitometry 2014). Hence, TBS was evaluated in serial DXA scans (Hologic Discovery W) conducted triennially in all active and retired astronauts and more frequently (before spaceflight, after spaceflight and until recovery) in the subset of astronauts flying 4-6-month missions. We used non-linear models to describe trends in observations (BMD or TBS) plotted as a function of astronaut age. We fitted 1175 observations of 311 astronauts, pre-flight and then post-flight starting 3 years after landing or after astronaut's BMD for LS was restored to within 2% of preflight BMD. Observations were then grouped and defined as follows: 1) LD: after exposure to at least one long-duration spaceflight > 100 days and 2) SD: before LD and after exposure to at least one short-duration spaceflight < 30 days. Data from males and females were analyzed separately. Models of SD observations revealed that TBS and BMD had similar curvilinear declines with age for both male and female astronauts. However, models of LD observations showed TBS declining with age while BMD appeared stable or trending upward. For females (n=8) LD observations were too few to discern a trend. Notably, models describing trends in TBS appeared to be more sensitive to the effects of age than the models for BMD. We conclude that TBS may provide an additional index for the lumbar spine to monitor the combined changes due to spaceflight and due to aging. This increased knowledge may enhance the ability to identify an intervention trigger for premature vertebral fractures in astronauts.